May 3, 1932. E. LYNDON 1,856,715

HEAT RESPONSIVE CIRCUIT CLOSER

Filed May 18, 1927

Fig. 1

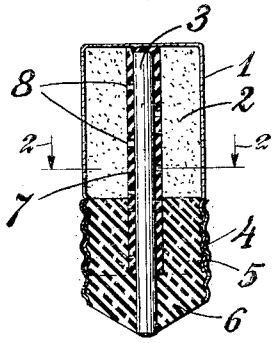


Fig. 2

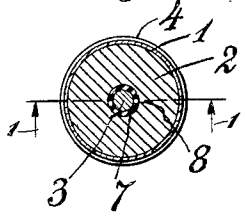


Fig. 3

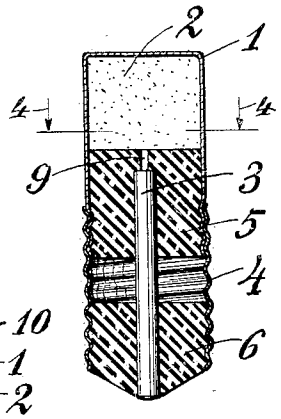


Fig. 4

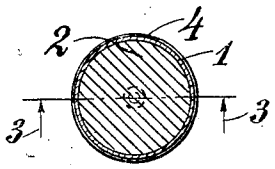
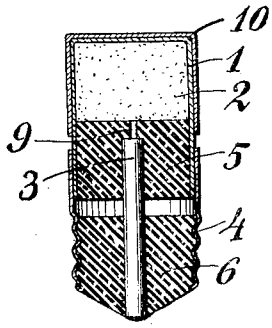


Fig. 5



Edward Lyndon
Inventor

By his Attorney
Alexander Chessin

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UNITED STATES PATENT OFFICE

EDWARD LYNDON, OF NEW YORK, N. Y.

HEAT RESPONSIVE CIRCUIT CLOSER

Application filed May 18, 1927. Serial No. 192,235.

My invention relates to circuit closers and, more particularly, to devices of this nature wherein the closing of the circuit is effected by the melting of an easily fusible metal.

The device is applicable to many useful purposes and is especially adapted for use in connection with fire alarm and detecting systems. Among its characteristic features are simplicity of structure and of operation, cheapness of manufacture, security against failure due to oxidation of the alloy or easily fusible metal, adaptability to become a part of a standard fixture, and reliability of its action which may be designed to be either very rapid or responsive only to sustained action of heat.

In the operation of my device, an alloy of low fusibility, rendered plastic by the action of heat, is discharged under pressure through a duct which is very small as compared with the volume of the alloy. As soon as the alloy is fused by the action of heat, the pressure developed in the space within which it is confined forces the fused mass through the small duct into contact with one of the terminals of the electrical circuit.

Several factors contribute to the almost instantaneous and certain operation of my device when it is designed for rapid action. The alloy is confined within a metal shell of high heat conductivity, the area of the walls of this shell being large enough to absorb and conduct a sufficient amount of heat, and the walls being thin enough to insure a rapid passing of this heat into the confined mass of the fusible alloy, while the volume of the alloy is sufficiently great to produce, on heat expansion, the necessary pressure for the extrusion of the fused mass through the comparatively small duct, but not so great as to retard the process of heat absorbtion. The pressure not only effects a positive contact between the alloy and one of the terminals but also eliminates one of the most serious difficulties encountered in devices of this nature, namely, failure to function owing to oxidation of the exposed surface of the alloy. It is impossible to entirely prevent the air from coming into contact with the alloy, and such a contact ultimately results in oxidation of the exposed surface of the alloy. Then, as this oxidized surface, during the operation of the device, is brought into contact with a terminal, enough resistance is created to the passage of current, which is very small in the application of such systems, to prevent or stop all functioning of the device. But when the contact is effected under pressure, as in applicant's device, the oxidized surface of the alloy is forced out and broken up and clean parts of the alloy are discharged through the broken surface of oxidation.

The metal shell within which the alloy is enclosed has a comparatively high fusing point so that it retains its shape and continues to confine the enclosed alloy while the latter first softens and then fuses. The coefficient of expansion of the alloy is considerably greater than that of the metal in the shell so that the slight expansion of the shell under the action of heat is not sufficient to allow for the expansion of the alloy, and the latter must seek an outlet through the only passage way open to it, and the smaller this passage way is as compared to the volume of the alloy, the greater will be the force with which the alloy will be discharged through it.

Referring to the drawings, Figure 1 is a vertical cross section through one form of my invention; Figure 2 is a cross section through the body of my device along the line 2—2 of Figure 1. Figures 3 and 4 are similar cross sections of another form of my invention. Figure 5 is a similar cross sectional view of a modification of my invention.

The two forms of my invention illustrated in Figures 1, 2 and 3, 4, respectively, embody the same type of the device inasmuch as their application covers the case of an almost instantaneous or, at least, very rapid absorption of heat from the surrounding atmosphere. In some cases, it is desirable to make the operation subject to a sustained action of heat only. It is well known that many of the present day fire detecting and fire preventing systems suffer from a recurrence of false alarms due to the closing of the electrical circuit caused by some temporary, sudden rise of temperature adjacent

the circuit closer. To avoid such false alarms, I provide for a certain amount of sustained action of heat before the closing of the circuit, so that the device becomes operative only upon a continual and sufficiently long influence of heat in the surrounding atmosphere upon the fusible metal confined in the space provided for it in my device. I may, for instance, increase the volume of this fusible metal in the forms of my device shown in Figures 1 to 4, so that it will take a longer period of time to heat the fusible metal to the necessary plastic stage, or I may cover the heat responsive element by a protective coating. The latter type of my invention is illustrated in Figure 5.

In the figures, 1 is an inverted metal cup of comparatively high fusing point; 2 is an easily fusible alloy; 3 is a metal conductor; 4 is a threaded plug adapted to fit into a standard electric socket, preferably of the candelabrum or miniature type; 5 and 6 are blocks of insulating material, partly for the purpose of electrical insulation and partly to reinforce the metal shells of the cup 1 and plug 4; 7 (in Figures 1 and 2) is an electrical insulation over the metal conductor 3, provided with perforations 8; 9 (in Figures 3 and 4) is a passage way between the alloy 2 and the metal conductor 3, within the insulating block 5; and 10 (in Figure 5) is a protective coating.

I may, of course, have a plurality of ducts 9 in the form of my invention illustrated in Figures 3, 4, as well as in the form shown in Figures 1, 2. Whether I use a single duct, or a plurality of them, I prefer to make the total volume of these open ducts much less than the volumetric increase of the alloy or easily fusible metal 2 when the latter is heated to the plastic state, so that when the plastic mass is caused to be extruded, i. e. forcibly discharged, through the duct or ducts, it will completely fill them and thus effect an operative contact with the metal conductor or terminal 3. It should be noted that these ducts are open, i. e. unobstructed all the way from the fusible metal 2 to the conductor 3, and that the area of contact, i. e. the opening of the duct at the place of fusion with the conductor 3, is sufficiently great to offer no appreciable resistance to the passage of the small current used in the application of such devices. When the passage is obstructed, as, for instance, by a permeable insulation, sometimes used in devices of this general character, there is always danger of a faulty contact, and this danger is enhanced by the fact that, in such arrangements, the contact, at best, is effected only along a fraction of the total contact area.

In the operation of the device, the plug 4 serves as one of the terminals of the circuit, the other terminal being the metal conductor 3.

In Figure 5, the plug 4 is shown as joined to the cup 1 by a plain, tight fit, as distinguished from the threaded joint in Figures 1 and 3. Otherwise, the device shown in Figure 5 differs from the one illustrated in Figures 3, 4, only by the addition of the coating 10 on the cup 1. This coating, which may naturally be applied to the cup 1 in the device shown in Figures 1, 2, as well, is of a substance variously permeable to heat, according as to how long it is desired to have the influence of heat sustained before effecting a closure of the circuit. The coating 10 may be of a nonmetallic material or any other substance suitable for the purpose specified.

Having fully described my invention, I claim:

1. In a circuit closer, an inverted cup of a metal having a comparatively high fusing point, an easily fusible metal confined within said cup and in contact therewith, a plug fitted to said cup at the open end thereof and adapted to be a terminal of said circuit, a second terminal of said circuit within said plug and an electrical insulation between said terminals provided with a duct from said easily fusible metal to said second terminal.

2. In a circuit closer, an inverted cup of metal having a comparatively high fusing point, an alloy of comparatively low fusibility confined within said cup and in contact therewith, a plug fitted to said cup at the open end thereof and adapted to fit into a standard electric socket, a metallic conductor within said plug electrically insulated therefrom, and an electrical insulation between said alloy and said metallic conductor provided with a duct for the passage of said alloy when heated to a plastic state.

3. The combination with a heat responsive body comprising a container cup, of an easily fusible metal confined within said container cup and adapted to absorb heat from said body, an impermeable electrical insulation within said cup, and a metal conductor embedded in said insulation out of contact with said cup and easily fusible metal, said insulation being provided with a duct for the extrusion of said easily fusible metal when heated to a predetermined temperature, to establish contact with said metal conductor.

4. The combination with a body comprising a heat responsive element and a hollow chamber, of an easily fusible metal confined within said chamber and adapted to absorb heat from said heat responsive element, an impermeable electrical insulation in said chamber, and a metal conductor embedded in said insulation out of contact with said body and said easily fusible metal, said insulation being provided with a duct from said easily fusible metal to said metal conductor for the extrusion of said easily fusible metal when

heated to a plastic state to establish contact with said metal conductor.

5. The combination with a hollow heat responsive body, of an easily fusible metal confined therein and adapted to absorb heat therefrom, an impermeable electrical insulation in said hollow body, and a metal conductor embedded in said insulation out of contact with said hollow body, said insulation being provided with a duct from said easily fusible metal to said metal conductor for the extrusion of said easily fusible metal when heated to a predetermined temperature to establish contact with said metal conductor.

6. In a circuit closer, a body comprising an element adapted to be a terminal of said circuit and a heat responsive element in contact therewith, an alloy of low fusibility confined within said body and in contact with said heat responsive element, an impermeable electrical insulation in said body, and a second terminal of said circuit embedded in said insulation out of contact with said body, said insulation being provided with a duct between said alloy and said second terminal for the extrusion of said alloy when heated to a plastic state to establish contact with said second terminal.

7. In a circuit closer, a shell of metal having a comparatively high fusing point, an easily fusible metal confined within said shell and in contact therewith, an impermeable electrical insulation in said shell, and a terminal of said circuit embedded in said insulation out of contact with said shell and said easily fusible metal, said insulation being provided with a duct between said easily fusible metal and said terminal for the extrusion of said easily fusible metal to make contact with said terminal when heated to a predetermined temperature.

8. The combination with a body comprising a heat responsive element and a hollow chamber, of an easily fusible metal confined within said chamber and adapted to absorb heat from said heat responsive element, an impermeable electrical insulation in said chamber, and a metal conductor embedded in said insulation, said insulation being provided with a plurality of ducts from said easily fusible metal to said metal conductor.

9. In a circuit closer, a body comprising an element adapted to be a terminal of said circuit and a heat responsive element in contact therewith, an alloy of low fusibility confined within said body and in contact with said heat responsive element, an impermeable electrical insulation in said body, and a second terminal of said circuit embedded in said insulation out of contact with said body, said insulation being provided with a plurality of ducts between said alloy and said second terminal.

10. The combination with a heat responsive body and comprising a hollow chamber, of means for reducing the heat responsiveness of said body, an easily fusible metal confined within said chamber and adapted to absorb heat from said body, a metal conductor within said body, and a duct between said chamber and said conductor, the volume of said duct being less than the volumetric increase of said easily fusible metal when heated to a plastic state.

11. The combination with a metal container comprising a rapidly heat responsive element, of an easily fusible alloy confined within said heat responsive element and adapted to absorb heat therefrom, a slowly heat responsive coating for said rapidly heat responsive element, a metal conductor, and a duct between said alloy and said conductor, the volume of said duct being less than or substantially equal to the volumetric increase of said alloy when heated to a predetermined temperature, allowing for the expansion of said heat responsive element.

12. In a circuit closer, an inverted cup of metal having a comparatively high fusing point, an alloy of comparatively low fusibility confined within said cup, a heat permeable coating on said cup, a plug fitted to said cup at the open end thereof and adapted to fit into a standard electric socket, a metal conductor within said plug electrically insulated therefrom, and a duct between said alloy and said conductor, the volume of said duct being less than the volumetric increase of said alloy when heated to a plastic state.

13. The combination with a container cup of metal having a comparatively high fusing point, of an alloy of low fusibility confined therein, an impermeable insulating material filling the balance of the space within said container cup, and a metal conductor embedded in said insulating material out of contact with said cup and alloy, said insulating material being provided with a duct from said alloy to said metal conductor.

14. The combination with a heat responsive body comprising a hollow chamber, of an easily fusible metal confined within a portion of said chamber and adapted to absorb heat from said body, an impermeable insulating material filling another portion of said chamber, and a metal conductor embedded in said insulating material out of contact with said alloy, said insulating material being provided with a duct from said alloy to said metal conductor.

EDWARD LYNDON.